



# NASA ADVANCED SUPERCOMPUTING (NAS) DIVISION

## INTEGRATED HIGH-END COMPUTING ENVIRONMENT

High-end computing resources integrated with supporting technologies and services are essential for NASA mission assurance and safety.

### Benefit

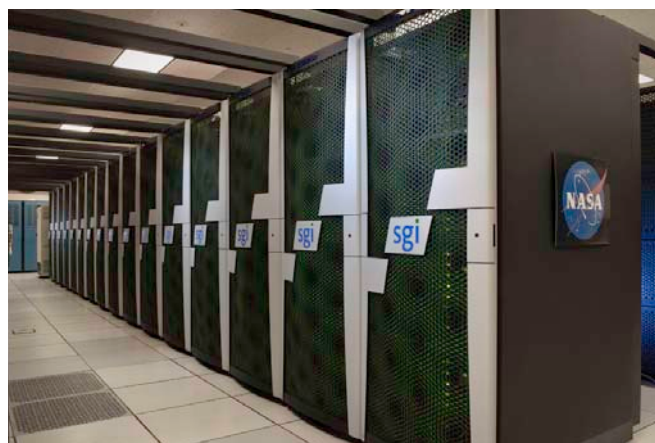
The NAS Division's innovative use of high-end computing (HEC) systems continues to greatly accelerate the development of modeling, simulation, and analysis technologies needed to meet NASA's evolving mission challenges. HEC experts at NAS have demonstrated a proven approach that enables scientists and engineers to swiftly resolve their toughest design, analysis, and prediction challenges in the areas of aeronautics research, exploration systems, Earth and space sciences, and space operations.

### Overview

Key to NAS' approach to HEC is the collaboration among our interdisciplinary product teams with broad and deep knowledge of advanced systems and technologies. These teams are supported by a balanced infrastructure comprised of world-class supercomputers, high-speed networks, massive data repositories, software porting and optimization services, modeling and simulation, data analysis and scientific visualization, and 24x7 user support. Each of the following elements is key to providing technologies for NASA's current and future mission challenges.

### Production Supercomputing

The NAS Division's expertise in developing and delivering HEC technologies is at the center of its integrated environment. The systems group evaluates new architectures; acquires, installs, and manages these systems; and develops custom software tools and advanced security methods. This team, along with industry partners, has continuously expanded the Pleiades supercomputer to meet NASA's growing HEC requirements. Originally built in October 2008, Pleiades now has 162,496 cores, with a total sustained processing capability of 1.54 petaflops.



*The Pleiades supercomputer, housed at the NAS facility, has recently been expanded to its present 162,496 cores.*

### High-Speed Networking

NAS' high-capacity connections and network expertise allow users' massive data transfers—some of which are many terabytes in size—to occur seamlessly between local and remote systems. The NAS facility currently houses the world's largest InfiniBand network, with 65 miles of cabling. Our engineers stay on the forefront of, and strongly influence the future of networking technologies to ensure that NASA's unique computational requirements are met.

### Mass Data Storage

The NAS facility provides users with a 115-petabyte (PB) archive storage capacity and 3.1 petabytes (PB) of online disk cache spread across two main archive systems. This is in addition to approximately 10 PB of disk storage attached to NAS supercomputing and data analysis systems, allowing users to archive and retrieve important results quickly, reliably, and securely. NAS provides customized training and support to help users efficiently manage and transfer large amounts of data. Currently, the archival storage system contains 30 PB of unique data.

### *Application Performance Optimization*

The NAS Division's application performance and productivity group is dedicated to helping Agency users optimize application performance, improve code scalability, and effectively port their codes to the supercomputers housed at the NAS facility. In addition, the team evaluates advanced hardware and software technologies to identify and leverage those best suited to meet evolving HEC challenges for NASA.

### *Data Analysis & Scientific Visualization*

NAS visualization experts develop and implement advanced software tools and data analysis technologies customized to help scientists and engineers make new discoveries for Agency missions. The team's extensive repertoire includes a sophisticated concurrent visualization framework, which— together with the hyperwall-2 visualization system—allows users to explore high-resolution results in real time and pinpoint critical details in large, complex datasets.

### *24x7 User Support*

The NAS user services team is dedicated to assuring that Agency users can make the most effective, productive use of HEC systems at the facility, around-the-clock. The control room staff provides immediate response to all user questions, and coordinates end-to-end user services with other NAS teams to offer any custom support services

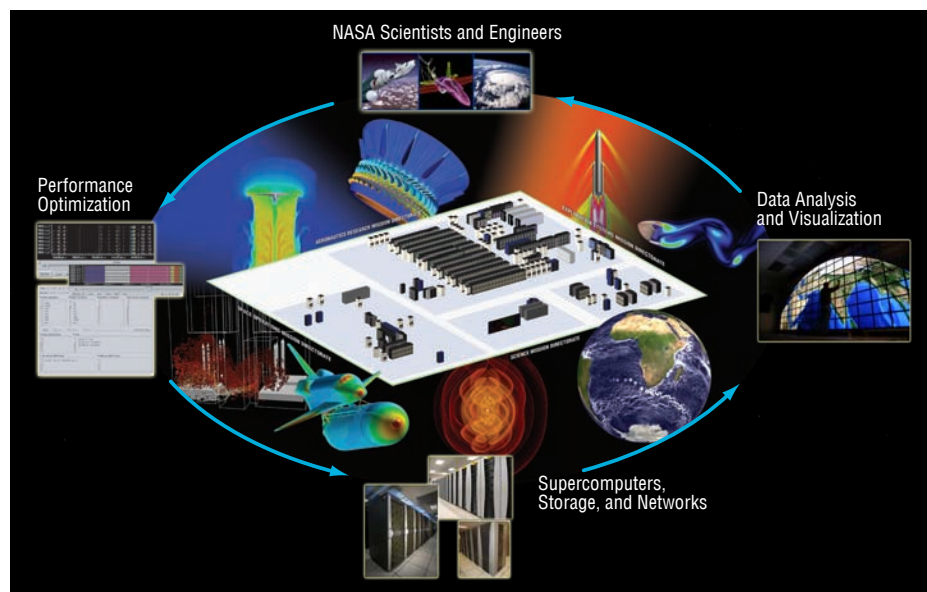
needed. The team continuously monitors and fine-tunes all systems, peripherals, and job processes to ensure a stable and secure supercomputing environment.

### *High-Fidelity Modeling and Simulation*

Many NASA missions present unique computational challenges that no commercial-off-the-shelf software can address. NAS scientists who specialize in physics-based modeling and simulation develop world-class computational fluid dynamics (CFD) software packages, custom tools, and advanced capabilities to meet these challenges. NAS CFD experts provide critical simulation services to Agency teams, often dramatically reducing time-to-solution and substantially increasing model resolution and accuracy.

### **Background**

For more than 25 years, the NAS Division has been known worldwide for its innovation and expertise in HEC, providing scientists and engineers with comprehensive supercomputing resources and services to support modeling and simulation challenges for the Agency. Together with industry, university, and government partners, NAS' HEC resources and integrated services will continue supporting Agency missions to conduct pioneering aeronautics research, design future space vehicles, make scientific discoveries, and gain a better understanding of the universe.



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